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(11) EP 1 096 609 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.05.2001 Bulletin 2001/18

(51) Int. Cl.⁷: H01R 12/16, H01R 13/20,
H01R 13/24, H01R 13/405

(21) Application number: 00117163.6

(22) Date of filing: 10.08.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 25.10.1999 JP 30195199

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(54) Locking mechanism for securely preventing disconnection between a plug and a receptacle

(57) In a plug connector (1) for being connected to a receptacle connector (2) in a first direction, a plug contact (13) is held by a plug housing (11) and has a principal surface extending along the first direction. The plug contact is formed with a concave portion recessed from the principal surface in a second direction perpendicular to the first direction. A wall is remained between the principal surface and the concave portion. In the receptacle connector (2), a receptacle housing (21) holds a receptacle contact (23) for coming in contact with the plug contact in the second direction. The receptacle contact is formed with a projection (23d) which is positioned inside the concave portion when the plug connector is connected to the receptacle connector.

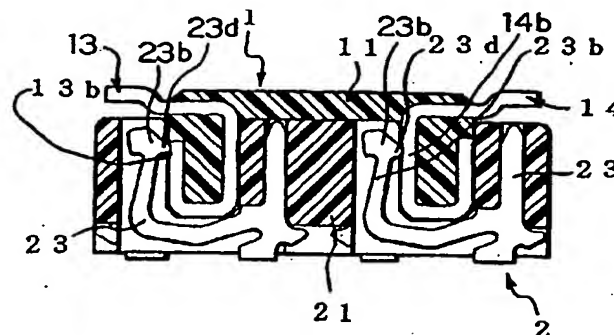


FIG. 9

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Description

Background of the Invention:

[0001] The present invention relates to an electrical connector and, more particularly, to an electrical connector for electrically connecting printed circuit boards or the like.

[0002] An electrical connector is used for electrically connecting printed circuit boards or electrically connecting a printed circuit board and an electrical cable such as a flexible printed circuit (hereinafter referred to as "FPC"). Such an electrical connector normally includes a plug connector and a receptacle connector to be connected to the plug connector.

[0003] To prevent disconnection between the plug connector and the receptacle connector, for example, disclosed in Japanese Patent No. 2676063 is a locking mechanism for engaging contacts of the plug connector with contacts of the receptacle connector. Since the contacts are normally made of material such as metal that is hard to be worn against the rubbing, the deterioration of the locking mechanism as a result of repeated insertion of the plug connector into the receptacle connector is extremely low.

[0004] However, the locking mechanism has the following problems.

[0005] When the connector is small and thin and has densely-arranged contacts, a mechanism for holding the contacts in a housing is complex so that it is impossible to provide large force for holding the contacts in the housing. Therefore, there are possibilities that the contacts come off the housing when the plug connector is removed from the receptacle connector and that the dimensional accuracy at contact portions of the contacts and soldered portions of the contacts becomes worse.

[0006] In case that the housing and the contacts are integrally formed, an outer surface of a mold may rub the contact surfaces of the contacts when the mold is released. The contact surfaces of the contacts may be scratched so that surface treatment including gold plating on the contact surfaces and/or sealing provided for treating the gold plating is affected. In this case, it is difficult to provide suitable electrical contact.

Summary of the Invention:

[0007] It is therefore an object of the present invention to provide an electrical connector which has a locking mechanism for securely preventing disconnection between a plug connector and a receptacle connector.

[0008] It is another object of the present invention to provide an electrical connector of the type described, which can provide large force of holding contacts to a housing and is suitable for an integral molding of the housing and the contacts.

[0009] Other objects of the present invention will

become clear as the description proceeds.

[0010] According to an aspect of the present invention, there is provided an electrical connector comprising a plug connector and a receptacle connector which are adapted to be connected to each other in a first direction, the plug connector comprising a plug housing and a plug contact held by the plug housing, the receptacle connector comprising a receptacle housing and a receptacle contact held by the a receptacle housing for coming in contact with the plug contact when the plug connector is connected to the receptacle connector, one of the plug contact and the receptacle contact having a principal surface extending along the first direction, a concave portion recessed from the principal surface in a second direction perpendicular to the first direction, and a wall between the principal surface and the concave portion, another of the plug contact and the receptacle contact having a projection which is positioned inside the concave portion when the plug connector is connected to the receptacle connector.

[0011] According to another aspect of the present invention, there is provided a plug connector for being connected to a receptacle connector in a first direction, the plug connector comprising a plug housing and a plurality of plug contacts held by the plug housing for coming in contact with the receptacle connector, each of the plug contacts having a principal surface extending along the first direction, a concave portion recessed from the principal surface in a second direction perpendicular to the first direction, and a wall between the principal surface and the concave portion.

[0012] According to still another aspect of the present invention, there is provided a receptacle connector for being connected to the above-mentioned plug connector, the receptacle connector comprising a receptacle housing and a plurality of receptacle contacts held by the receptacle housing for coming in contact with the first-mentioned contact portion in the second direction, each of the receptacle contacts having a projection which is positioned inside the concave portion when the plug connector is connected to the receptacle connector.

Brief Description of the Drawings:

[0013]

Fig. 1 is a perspective view showing a plug connector included in an electrical connector according to a first embodiment of the present invention;

Fig. 2 is an enlarged view of a main part of a contact included in the plug connector of Fig. 1;

Fig. 3 is a front view of the plug connector shown in Fig. 1;

Fig. 4A is a sectional view taken along a line IVa-IVa of Fig. 3;

Fig. 4B is a sectional view taken along a line IVb-IVb of Fig. 3;

Fig. 4C is a sectional view taken along a line IVc-IVc of Fig. 3;

Fig. 5 is a perspective view showing a receptacle connector included in the electrical connector according to the first embodiment of the present invention;

Fig. 6 is a front view of the receptacle connector shown in Fig. 5;

Fig. 7A is a sectional view taken along a line VIIa-VIIa of Fig. 6;

Fig. 7B is a sectional view taken along a line VIIb-VIIb of Fig. 6;

Fig. 7C is a sectional view taken along a line VIIc-VIIc of Fig. 6;

Fig. 8 is an explanatory view showing the plug connector of Fig. 1 and the receptacle connector of Fig. 5 before the connection;

Fig. 9 is an explanatory view showing the plug connector of Fig. 1 and the receptacle connector of Fig. 5 connected to each other;

Fig. 10 is an explanatory view showing the state that the plug connector of Fig. 1 is integrally formed;

Fig. 11 is a perspective view showing a plug connector included in an electrical connector according to a second embodiment of the present invention;

Fig. 12 is a front view of the plug connector of Fig. 11;

Fig. 13A is a sectional view taken along a line XIIIa-XIIIa of Fig. 12;

Fig. 13B is a sectional view taken along a line XIIIb-XIIIb of Fig. 12; and

Fig. 13C is a sectional view taken along a line XIIIc-XIIIc of Fig. 12.

Description of the Preferred Embodiments:

[0014] With reference to Figs. 1 through 9, description will be made as regards an electrical connector according to a first embodiment of the present invention.

[0015] The electrical connector includes a plug connector 1 and a receptacle connector 2 which are connected to or disconnected from each other in a first direction. The following description will be made assuming that the plug connector 1 and the receptacle connector 2 are arranged on a circuit board, but it should be understood that the present invention is not limited thereto.

[0016] Referring to Fig. 1 through Fig. 4C, the plug connector 1 includes a plug housing 11 made of an insulating material such as synthetic resin and a plurality of plug contacts 13 and 14 parts of which are fixed and held in a plurality of parallel grooves 12 formed in the housing 11. The contacts 13 are aligned in parallel on the left side of the housing 11 in Figs. 4A-4C. The contacts 14 are aligned in parallel on the right side of the housing 11 in Fig. 1.

[0017] Each of the contacts 13 has a board con-

necting portion 13a connected by soldering or the like to an electrical circuit on the circuit board (not shown) on which the plug connector 1 is arranged and a contact portion 13b which comes in contact with a corresponding contact of the receptacle connector 2 when the plug connector 1 is connected to the receptacle connector 2. Each of the contacts 14 has a board connecting portion 14a and a contact portion 14b which are similar to the board connecting portion 13a and the contact portion 13b, respectively. Though the contacts 13 have the same configuration and the same size as those of the contacts 14, the configuration of the contacts 13 may be different from that of the contacts 14, for example, in that concave portions are formed in different positions.

[0018] As particularly shown in Fig. 2, the description will be directed to one of the plug contacts 13 and 14. In the plug contact 13, the contact portion 13b has a principal flat surface 13d formed with a concave portion 13c having a surrounding wall 13e. More particularly, the contact portion 13b has the principal flat surface 13d, the concave portion 13c recessed from the principal flat surface 13d in a second direction perpendicular to the first direction, and the wall 13e surrounding the concave portion 13c between the principal flat surface 13d and the concave portion 13c. The concave portion 13c can be formed for example by coining a relating portion of the plug contact 13. Though the concave portion 13c are quadrate in the illustrative example, it is not limited thereto and may be circular or elliptical in form. It is to be noted that the other plug contact 14b has structure similar to that of the above-mentioned plug contact 13.

[0019] Referring to Figs. 5 through 7C, the receptacle connector 2 includes a receptacle housing 21 made of an insulating material such as synthetic resin and a plurality of receptacle contacts 23 parts of which are fixed and held in a plurality of parallel grooves 22 formed in the housing 21. The receptacle connector 2 is provided with spaces 24 and 25 for fitting the plug connector 1 therein.

[0020] Each of the receptacle contacts 23 has a board connecting portion 23a connected by soldering or the like to an electrical circuit on a circuit board (not shown) on which the receptacle connector 2 is arranged, a contact portion 23b which comes in elastic contact with a corresponding contact of the plug connector 1 when the plug connector 1 is connected to the receptacle connector 2, and a press fitting portion 23c inserted into the housing 21. The contact portion 23b is formed at one end thereof with a projection 23d protruding in the second direction.

[0021] The contact portion 23b has substantially a C-like configuration extending from the board-connecting portion 23a and the press fitting portion 23c. Because of this configuration, the contact portion 23b has elasticity (like a spring) in the second direction or the right-left direction of Fig. 7A.

[0022] Hereinafter, the description will now be made as regard to a case in which the plug connector 1

and the receptacle connector 2 are connected to each other. In the case, the plug connector 1 is positioned above the receptacle connector 2 to face the plug connector 1 with the spaces 24 and 25 of the receptacle connector 2 as shown in Fig. 8. Then, the plug connector 1 is fitted into the spaces 24 and 25. As a result, the plug connector 1 and the receptacle connector 2 are connected to each other so that the contact portions 13b and 14b of the contacts 13 and 14 of the plug connector 1 come in contact with the contact portions 23b of the contacts 23 of the receptacle connector 2 as shown in Fig. 9.

[0023] Since the contact portions 23b of the contacts 23 are elastic as mentioned above, the contact portions 13b and 14b are in elastic contact with the contact portions 23. The projection 23d of the contact portion 23b of the each contact 23 is inserted in the concave portions 13c and 14c formed in the contact portion 13b and 14b of the each contact 13, 14. This elastic press fitting of the projections 23d with the concave portions 13c and 14c composes or forms a locking structure or mechanism for securely preventing the disconnection between the plug connector 1 and the receptacle connector 2.

[0024] Fig. 10 shows one of steps for making the plug connector 1 by integral molding of the housing 11 and the contacts 13 and 14 and, more particularly, shows the state that a mold 3 is released after the integral molding. Even when an outer surface 31 of the mold 3 rubs the outer surface of the contact 14 during the release of the mold, the concave portion 14c which is an actual contact portion of the contact portion 14b is never scratched by the outer surface 31 because the concave portion 14c is positioned little back from other portion of the contact portion 14b.

[0025] With reference to Figs. 11 through 13C, the description will be made as regards an electrical connector according to a second embodiment of the present invention.

[0026] The electrical connector includes a plug connector 4. The plug connector 4 includes a housing 41 made of an insulating material such as synthetic resin and a plurality of contacts 43 which are fixed and held by contact holding portions 42 disposed on the both sides of the housing 41 and are aligned in parallel. The contacts 43 are aligned on the right and left contact holding portions 42 alternately i.e. in a zigzag configuration.

[0027] Each of the contacts 43 has a board connecting portion 43a connected by soldering or the like to an electrical circuit on the circuit board (not shown) on which the plug connector 4 is arranged and a contact portion 43b which comes in contact with a corresponding contact of a receptacle connector (not shown) when the plug connector 4 is connected to the receptacle connector. The contact portions 43b have flat surfaces each of which is formed with a concave portion 43c having surrounding walls.

[0028] The plug connector 4 is connected to the receptacle connector which is similar to that described with reference to Figs. 1-9. In this state, the contact portions 43b are in elastic contact with corresponding contact portions of the contacts of the receptacle connector and corresponding projections of the contacts of the receptacle connector are elastically press fitted in the concave portions 43c, thereby composing a locking structure or a locking mechanism for preventing the disconnection between the plug connector 4 and the receptacle connector.

[0029] In the above-mentioned electrical connector, contact portions of plug contacts or receptacle contacts are composed of concave portions, each having surrounding walls, formed in flat surfaces of either the plug contacts or the receptacle contacts and projections to be positioned inside the concave portions when the connectors are connected to each other. The concave portions and the projections serve as a locking mechanism for preventing the disconnection between the plug connector and the receptacle connector.

[0030] Since the concave portions having the surrounding walls are formed in the flat surface of the contact portions, resin never enters into the concave portions during the integral molding so that the housing and the contacts of the connector are integrally formed. Further, since the concave portions are formed to have surrounding walls, i.e., formed by denting a portion of the flat surface, the concave portions never be scratched by an outer surface of a mold when the mold is released after the integral molding so that gold plating on the contact surfaces and/or sealing provided for treating the gold plating is not affected, thereby providing suitable electrical contact.

Claims

1. An electrical connector comprising a plug connector and a receptacle connector which are adapted to be connected to each other in a first direction;

said plug connector comprising a plug housing and a plug contact held by said plug housing;
said receptacle connector comprising a receptacle housing and a receptacle contact held by said a receptacle housing for coming in contact with said plug contact when said plug connector is connected to said receptacle connector;
one of said plug contact and said receptacle contact having a principal surface extending along said first direction, a concave portion recessed from said principal surface in a second direction perpendicular to said first direction, and a wall between said principal surface and said concave portion;
another of said plug contact and said receptacle contact having a projection which is positioned inside said concave portion when said

plug connector is connected to said receptacle connector.

having a projection which is positioned inside said concave portion when said plug connector is connected to said receptacle connector.

2. An electrical connector as claimed in claim 1, wherein said concave portion is made in said plug contact, said projection being made in said receptacle contact. 5
3. An electrical connector as claimed in claim 1 or 2, wherein said plug contact is molded in said plug housing. 10
4. An electrical connector as claimed in one of claims 1 to 3, wherein said plug connector further comprises an additional plug contact held by said plug housing to arrange with the first-mentioned plug contact in a line, said receptacle connector further comprising an additional receptacle contact held by said receptacle housing to arrange with said first-mentioned receptacle contact in a line, said additional plug contact and said additional receptacle contact coming in contact with each other when said plug connector is connected to said receptacle connector. 15 20 25
5. An electrical connector as claimed in claim 4, wherein one of said additional plug contact and said additional receptacle contact has a principal surface facing another thereof, a concave portion recessed from the second mentioned principal surface in said second direction, and wall between the second-mentioned principal surface and the last-mentioned concave portion. 30
6. A plug connector for being connected to a receptacle connector in a first direction, said plug connector comprising: 35
 - a plug housing; and
 - a plurality of plug contacts held by said plug housing for coming in contact with said receptacle connector, each of said plug contacts having a principal surface extending along said first direction, a concave portion recessed from said principal surface in a second direction perpendicular to said first direction, and a wall between said principal surface and said concave portion. 40 45
7. A receptacle connector for being connected to a plug connector as claimed in claim 6, said receptacle connector comprising: 50
 - a receptacle housing; and
 - a plurality of receptacle contacts held by said receptacle housing for coming in contact with the first-mentioned contact portion in said second direction, each of said receptacle contacts 55

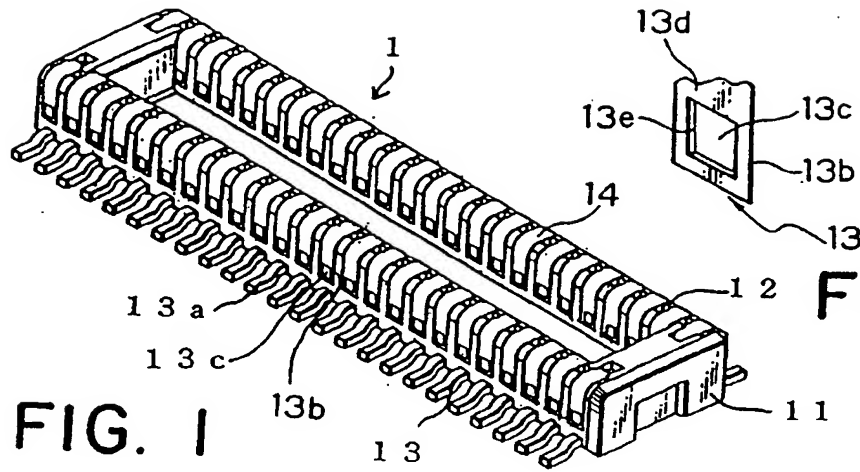
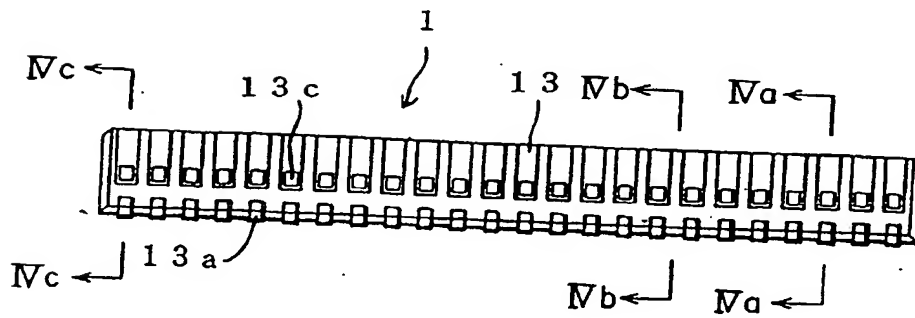


FIG. 2



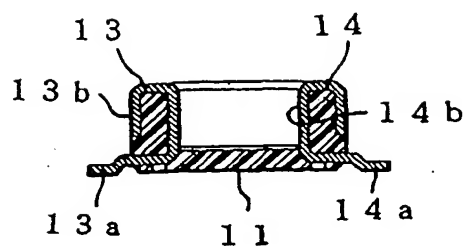


FIG. 4A

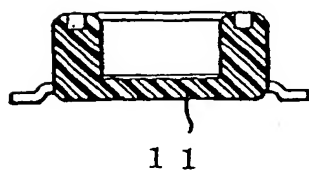


FIG. 4B

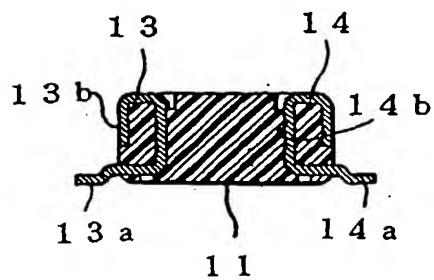


FIG. 4C

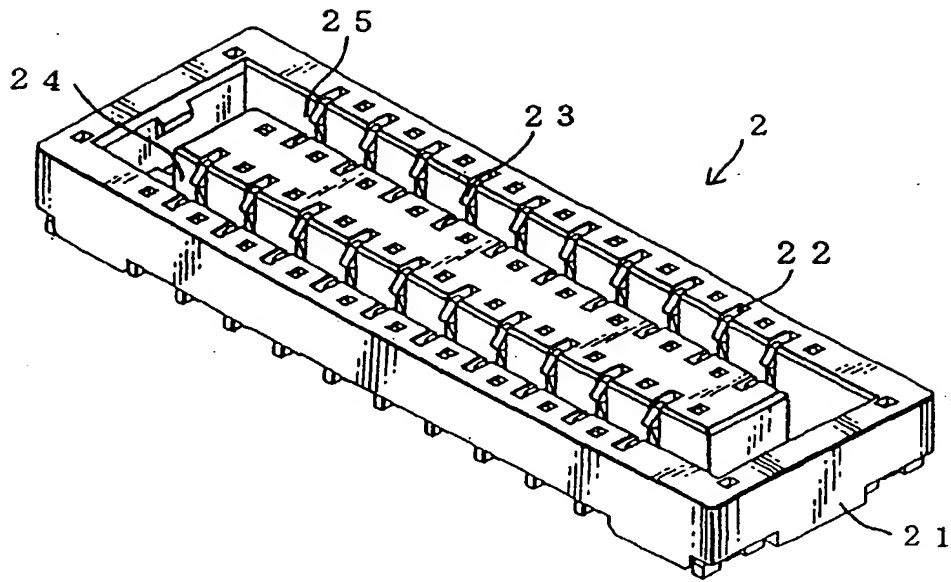


FIG. 5

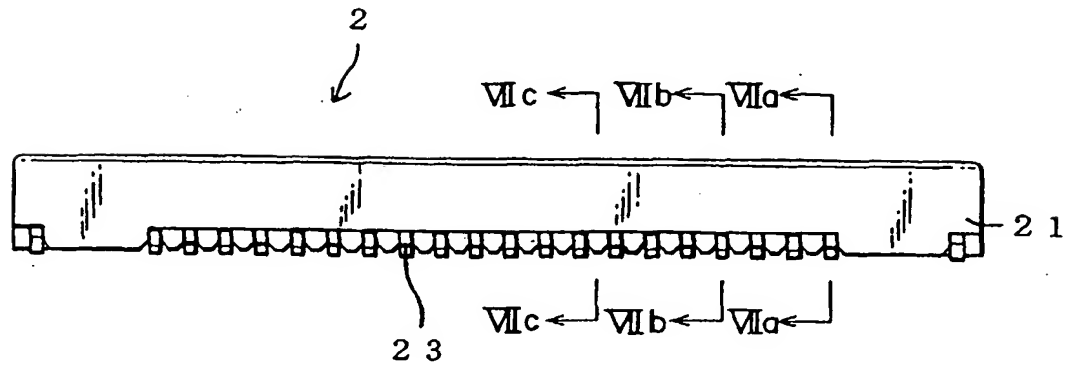


FIG. 6

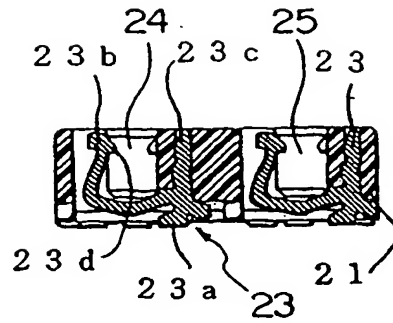


FIG. 7A

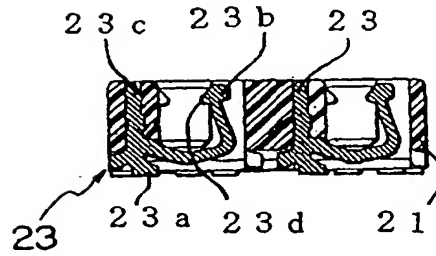


FIG. 7B

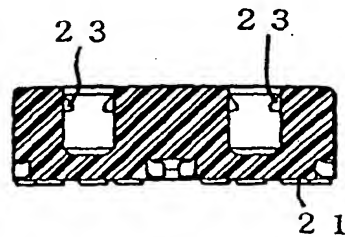
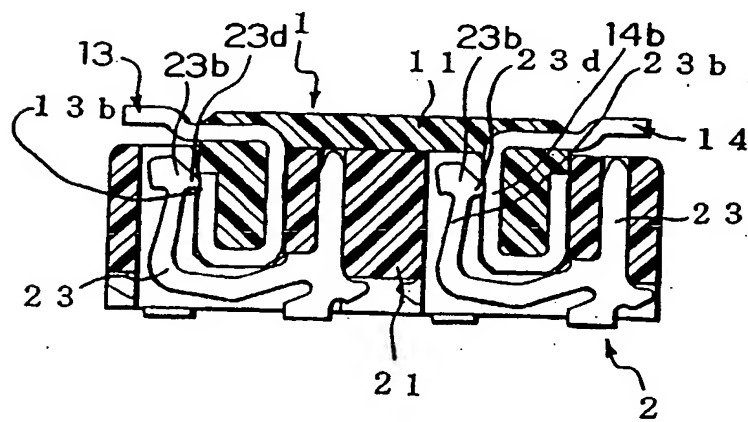
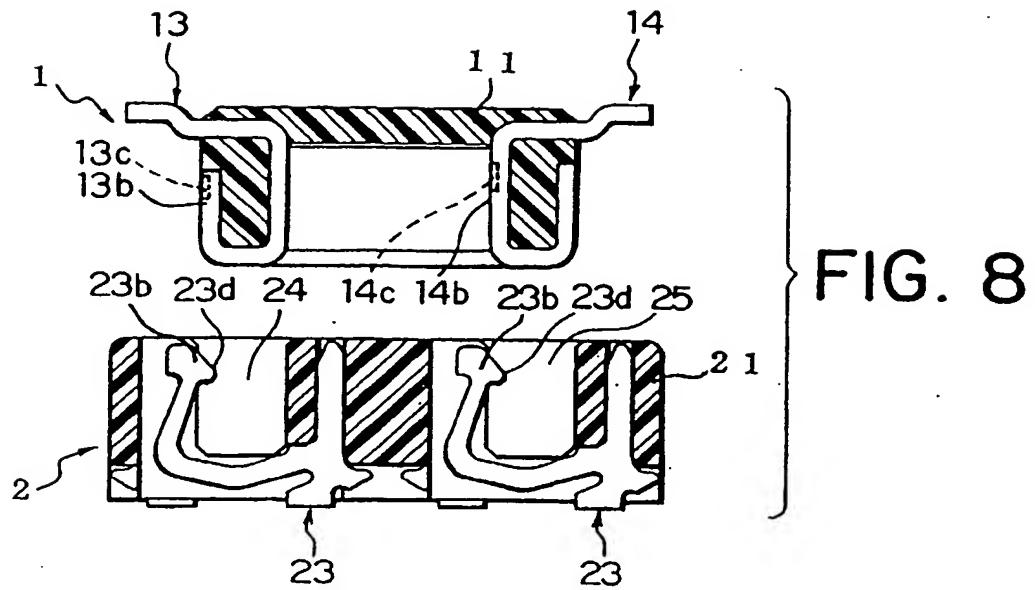


FIG. 7C



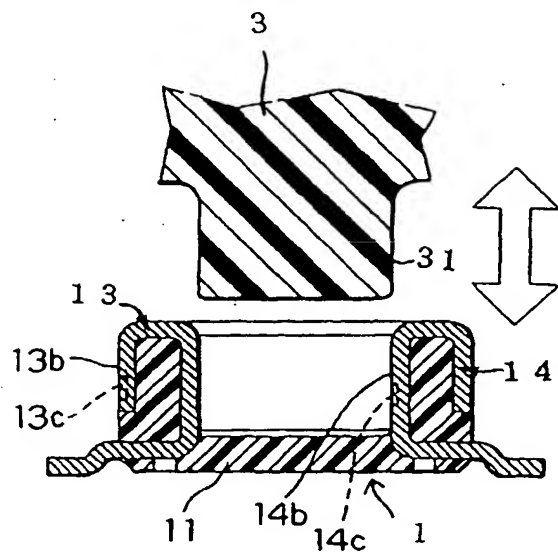


FIG. 10

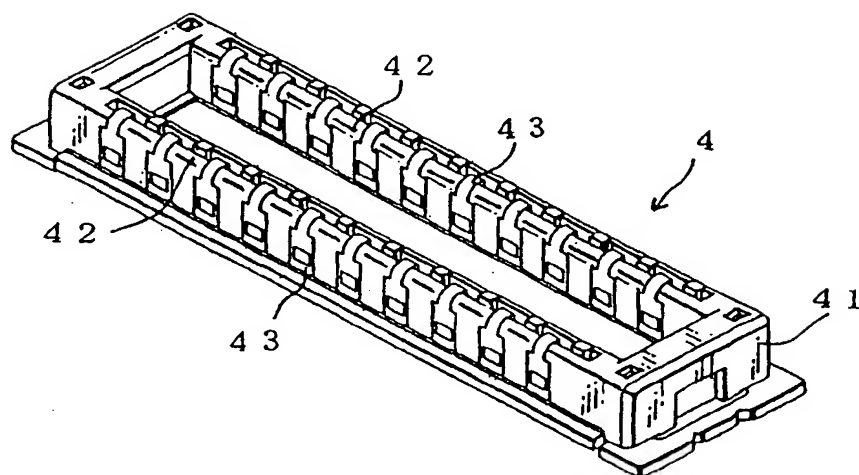


FIG. 11

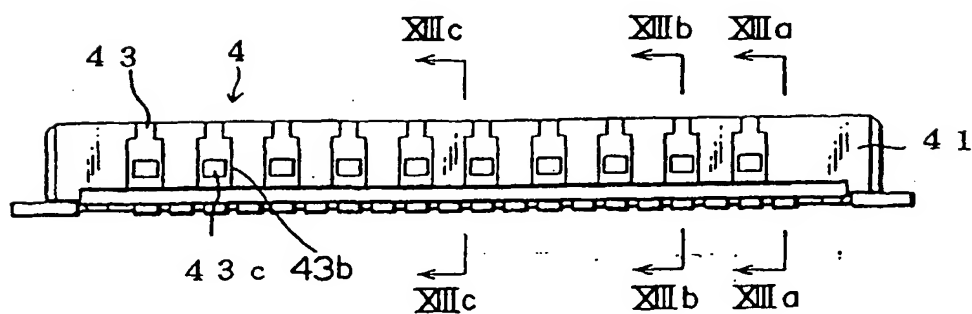


FIG. 12

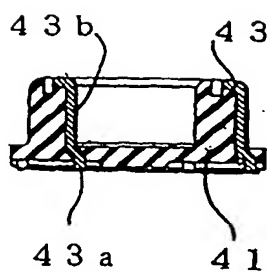


FIG. 13A

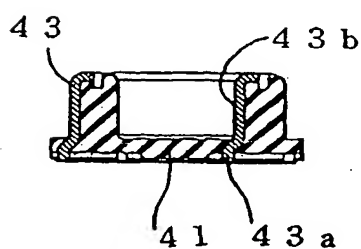


FIG. 13B

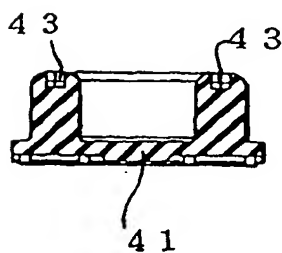


FIG. 13C



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EUROPEAN SEARCH REPORT

Application Number
EP 00 11 7163

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 450 770 A (AMP INC) 9 October 1991 (1991-10-09) * column 4, line 7 - column 9, line 16; figures 1-5 *	1,4-7	H01R12/16 H01R13/20 H01R13/24 H01R13/405
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Y	EP 0 795 929 A (MOLEX INC) 17 September 1997 (1997-09-17) * column 5, line 51 - line 54 *	3	
A	* the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01R
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 16 October 2000	Examiner Langbroek, A
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16-10-2000

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